Herrera, H. & Schroth, E. (2011). Advantageous Innovation in the Underwriting Market for Corporate Securities. Journal of Banking and Finance, 35(5), pp. 1097-1113. doi: 10.1016/j.jbankfin.2010.09.019

Advantageous Innovation and Imitation in the Underwriting Market for Corporate Securities*

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Abstract

Investment banks that develop new corporate securities systematically lead the new underwriting market despite being imitated early by equally competitive rivals. We study how innovators and imitators set underwriting fees in order to identify empirically the source of this advantage. Using data of innovative securities since 1985, we do find that innovators set systematically higher fees than imitators. This premium decreases as more issues occur, and faster for later generation products. Imitation is also quicker for later generations. This evidence supports the hypothesis that the innovator has superior skills in structuring any given issue of the new security.

JEL Classification: G24, L12, L89.

Keywords: Financial innovation, sequential innovation, investment banking, underwriters' expertise, learning.

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*We would like to thank Sugato Bhattacharyya, Michele Boldrin, Tom Chemmanur, Hendrik Hakenes, Charles Lucas, Preston McAffee, Erwan Morellec, Stewart Myers, Roberto Rigobon, Elu Von Thadden and seminar audiences at the 2004 FIRS Conference (Capri) and the 2005 CERF Conference on Financial Innovation (Cambridge). Enrique Schroth acknowledges financial support provided by the Swiss Finance Institute and FINRISK.

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Abstract

Investment banks that develop new corporate securities systematically lead the new underwriting market despite being imitated early by equally competitive rivals. We study how innovators and imitators set underwriting fees in order to identify empirically the source of this advantage. Using data of innovative securities since 1985, we do find that innovators set systematically higher fees than imitators. This premium decreases as more issues occur, and faster for later generation products. Imitation is also quicker for later generations. This evidence supports the hypothesis that the innovator has superior skills in structuring any given issue of the new security.

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Investment banks have been at the forefront of financial innovation for more than two decades, increasing the variety of securities that firms can issue to raise new funds. The volume that banks underwrite using these products has also taken an increasing proportion of the overall underwriting market. But innovation is followed by imitation: large, reputed banks avoid the research and development stage and compete with the innovator for underwriting mandates of the new security. Yet, the empirical evidence strongly suggests that the innovators of new securities are somehow able to preserve a competitive advantage over imitators.

Why this is the case is an open question. In the most recent survey, Tufano (2003) concludes that the mechanisms that reward innovation still remain to be studied. It is important and timely to study the source and the evolution of the innovator's advantage if we want to understand the incentives for banks to innovate. Indeed, authors still debate the wisdom behind the recent changes in the US patent laws without a measurement of how much banks gain from innovation without patent protection.[1]

This paper asks whether the innovator's advantage over its imitators comes from a superior expertise structuring and underwriting issues of the security it has developed. We conjecture that imitation is seemingly easy but effectively difficult. The imitator can learn the product design immediately but has to acquires the skills to structure new issues. This specific ability is private to the innovator but the imitator learns it as the new security is issued repeatedly.

To test this hypothesis, we employ a novel identification strategy: we compare the equilibrium underwriting fees of innovators and imitators along the life cycle of each innovation, and across innovations that occur sequentially. We derive this comparison from a stylized representation of underwriter competition, where the effects over time of the superior expertise hypothesis are clearly distinguished from those of other sources of bank heterogeneity. In particular, we show that in an equilibrium where both banks maximize their probability of getting the next mandate, the underwriting fee directly reflects the innovation-specific ability *differential* between innovator and imitators on top of underwriting costs and client switching cost. If there is a specific ability to learn, then this difference, and thus the fees, will be monotonically decreasing in the issue number, *ceteris paribus*.

We implement the empirical tests with a data set of some of the most significant innovations in the last 20 years. We analyze all new issues of equity-linked and corporate derivative securities found in Thomson's One Banker data base (formerly SDC).

These products have become increasingly important not only as a fertile ground for innovation but also as a large source of funds. Between 1985 and 2002 firms raised over $200 billion, which represents almost 16% of all the cash raised with common stock in the same period by all the firms in the US economy.[2] This class of securities has two other key characteristics: a high complexity of the securities' structures and a high variation in the actual engineering choices made by underwriters across issues (Schroth, 2006). Underwriters given the mandate have to specify a large number of parameters for each given issuer and investors characteristics at the time of the issue. Therefore, the bank's structuring ability must be an important determinant of this market's equilibrium.

All the banks that compete for underwriting mandates of innovative securities are large, reputed Wall Street firms. All of them have had underwriting relationships in the past with most issuers and have the ability to place large issues. We see that variables traditionally used to measure underwriter's competitiveness vary little across underwriters in these markets. Hence, we exploit variation in two previously overlooked characteristics of each issue: the issue order within the security and the generation number of each security. Indeed, these securities can be classified into product groups (index-tied principal, zero-coupon convertibles, mandatory convertible preferred, etc.). Moreover, innovations within groups occur in an observable sequence. Further, issues themselves happen sequentially. Univariate comparisons across generations already reveal that the innovator's market share leadership is smaller for late generations.

The evidence is strongly in favor of the superior expertise hypothesis. We identify this effect *over and above* other measures of the competitiveness of underwriters and show that it is of the first order. The estimated advantage is inherent to the security's innovator and is robust even to the presence of tough imitators. In particular, the underwriting fees set by innovators are larger than the imitators' for given generation and issue numbers. The innovator's fee for the first issue of first generations is on average between 10% and 15% higher than the imitators'. The difference is decreasing in the issue number, at a speed that increases with the generation number. On average, it takes between 9 and 12 issues of a first generation security for the imitator to compete at equal strength with the innovator. It takes less than two issues for 10th generation securities. This result is consistent with the intuition that later generation products typically build on a previous designs and are therefore less innovative than the previous generation, i.e., a smaller innovator's initial advantage.

The superior expertise hypothesis also has testable implications about the speed of imitation. If the innovator can provide a higher quality structuring and underwriting, then the probability that the imitator gets its first underwriting mandate at any given issue must be decreasing in the innovator's initial advantage. Our estimates of the hazard rate of imitation function show that the expected imitation times are decreasing with the security's generation number. Again, these estimates support our hypothesis and are also fully consistent with the estimates of the fees equations.

The hypothesis that innovators have a superior expertise has not been developed by the previous literature. There is anecdotal evidence mostly from practitioners' testimonies that suggests that reverse-engineering results in imperfect substitutes and that the innovator remains the most proficient issuer (Toy, 2001).[3] Clinical studies of the investment banking industry document how engineering skills vary across banks and that the necessary skills to structure the issue of a new corporate security take time to acquire (Eccles and Crane, 1988). The lack of development of this hypothesis may have been caused by Tufano's (1989) failure to find systematic differences in the underwriting fees of innovators and imitators. Indeed, Tufano's findings are inconclusive as to the source of the innovator's market leadership. What makes our results conclusive is the fact that we condition the comparison of fees between innovator and imitators on the issue timing and the generation number of the security.

The first formal test that the superior expertise plays an important role in financial innovation is performed by Schroth (2006). He estimates a structural model for the demand of underwriting services of innovators and imitators. To identify the innovator's advantage, this study focuses on the best way to instrument for underwriting fees. Here we look directly into the determination of the fees and identify the underwriters' relative abilities from fees data using the model.

Bhattacharyya and Nanda (2000) theoretically analyze the role of the costs of switching banks in financial innovation. They show that innovators can make positive profits despite fast imitation because they have loyal clienteles. Client loyalty implies that the innovator's profits may not be eroded by imitation, but it also implies that the advantage belongs to the second mover rather than to the first: if a bank can underwrite a perfectly imitated product for its own loyal clientele then, all else being equal, imitation should be more profitable than innovation because it saves the development costs. Also, we see empirically that even large banks have small market shares for some innovative products and this generally happens when they are imitators. We incorporate client loyalty à la Bhattacharyya and Nanda (2000) to the model and the empirical tests. The effects of past-relationships based loyalty measures on underwriting fees, if any, are very small relative to the effects of superior expertise.

Authors have mostly focused on the *diffusion* of financial innovation and the value to its end users (see Frame and White, 2004). Notably, Persons and Warther (1997) propose an information-based theory of the adoption of financial innovations by financing firms where non-adopters update their beliefs about the true value of innovative securities from the number of adopters. Thus, innovations diffuse in waves. Molyneux and Shamroukh (1996) search for the determinants of the speed of adoption of junk bonds. While this strand of the literature does not attempt to understand the incentives to innovate, our paper focuses directly on the dynamics of competition between the agents of corporate finance innovation, i.e., investment banks, during the innovation's life. Riddiough (2001) links the intermediation side with the investors' side of innovation by finding evidence that the structuring of commercial mortgage-backed securities responds to changes in credit agencies' and investors' valuation. Here we also argue that product structuring changes along the life cycle of a new security, but we take a step further and study the evolution of the structuring skills of different banks, and how this difference shapes the incentives to innovate.

This paper contributes also to the empirical banking literature (see Altinkilic and Hansen, 2000, for a synthesis). We follow this literature to specify the marginal cost of underwriting component in the underwriting fee, but we augment the specification to include the markup due to imperfect competition. Indeed, the size of the markup is determined in equilibrium as a function of the ability differential between the innovator and the imitator for given issue and generation numbers.

The evidence in this paper contributes to the ongoing debate about the costs and benefits of the recent strengthening of patents for business methods, which include most financial innovations. The evidence here shows that the innovator's profits and market leadership are maintained after imitation occurs but gradually fall over the life cycle of the new products (as conjectured by Van Horne, 1985). We also see that, the larger the market, the more mandates the innovator is able to secure early, effectively delaying the entry of imitators. It seems therefore that there is more need for patent protection in small, late-generation securities markets. The evidence also shows that innovation adds little value to the innovator and to the issuer in these markets. It seems likely then that the increased litigation required to protect such innovations will be wasteful, and also possible that the innovating banks will not even use it. Providing an answer to these questions is next in this line of research.

This paper has the following structure. Section I summarizes the data set and draws some preliminary conclusions to motivate and shape the empirical design. Section II lays out the empirical model and the testable implications of the superior expertise hypothesis. We test these predictions in Sections III and IV. Section V discusses some extensions to the model and further evidence to support them. Section VI summarizes the results and concludes briefly. The Appendices contain further robustness checks of the model and all the proofs.

I Data description

We use the New Issues data from Thomson One Banker to construct a data set of the market for underwriting mandates of innovative corporate securities. We include all issues of Equity-linked or Derivative corporate securities. We record the characteristics of each issue (underwriting fees, the lead underwriter, proceeds, security type), of its underwriter (e.g., past volume underwritten to date, by security classes) and of the issuer-underwriter pair (e.g., past relationships counts). As a new feature, we record also the order in which issues occur within a security type and the order of the security within the sequence of related innovations.

A Size of the new issues market

Equity-linked and derivative securities have been issued by corporations since 1985. There have been 665 issues until 2004 by 30 different lead underwriters involving 50 different securities. Each security has a distinct design feature that distinguishes it from already existing products. They appear in the debt (D), convertible debt (CD), preferred (P) and convertible preferred (CP) classes.

These products have become increasingly important not only as a fertile ground for innovation but also as a large source of funds. Between 1985 and 2002 firms raised over $200 billion, which represents almost 16% of all the cash raised with common stock in the same period by all the firms in the US economy. Table I shows that the average issue raises almost $234 million (standard deviation, $299 million), which is almost twice as large as the average issue using standard D, CD, P and CP in the same period (average $130 million, standard deviation $152 million).

Underwriting fees are on average large, i.e., 2.41% (standard deviation 1.16%), relative to the contemporaneous underwriting fees of standard products (average

1.14%, standard deviation 1.40%). Unlike the case of SEOs and IPOs, underwriting fees for equity-linked and corporate derivatives exhibit significant variation.

<INSERT TABLE I ABOUT HERE>

Panel B of Table I shows that 18 of the 50 securities have been imitated. Over 60% of all the issues recorded correspond to imitated securities. There is significant heterogeneity in the times to imitation, measured either as the number of issues or days before the entry of the first imitator. Despite being imitated early (after 2 median issues), innovators have on average the largest market share (0.57, standard deviation 0.23).

B Classification of corporate innovations

We classify all the securities following Schroth (2006).[4] Table II shows this classification. The securities are listed in the order in which they historically appear. The largest groups, in terms of the number of products, are the groups of convertible preferred equity and the group of tax-saving, income deferring securities. These groups also exhibit significant imitation activity. Innovations in standard debt products (RISRS) or zero-coupon convertible debt (LYONS) brought about relatively large and long lasting underwriting markets but do not seem to have provided a fertile ground for subsequent development.

<INSERT TABLE II ABOUT HERE>

C Participating underwriters

There are 98 bank-security pairs. It is clear from the list of participating banks that innovation and imitation in corporate products of the equity-linked or derivative type is a game between Wall Street's top banks. Most of them have vast underwriting experience, large placement capabilities and good relationships with institutional investors and frequent issuers. These characteristics are generally used in the investment banking literature to capture the heterogeneity across banks competing for underwriting mandates of SEOs and IPOs. Given that this data is concentrated on the top banks, we expect these characteristics to vary little across banks. We expect other sources of heterogeneity across banks and securities matter more in this data set.

D Characteristics of corporate innovations

An innovation is a new corporate security that a firm can issue to raise funds. The innovator competes with imitators to underwrite new issues of each given new security. To understand what may distinguish the innovator from its imitators, consider the following examples.

1. Examples

Preferred Equity Redemption Cumulative Stock (PERCS): PERCS are 3-year mandatorily convertible preferred shares that pay a fixed dividend. The conversion rate is one but the conversion value is capped if the common shares appreciate too much. Thus, each issue of PERCS specifies, among other things, the cap to the common stock returns, $\bar{r}$. The contract must also specify the dividends payable and the offer price (see Figure 1).

<INSERT FIGURE 1 ABOUT HERE>

Index-tied appreciation notes: Generic index-tied debt (ELKS, MITTS) will specify the stock, or index of stocks, whose price is tied to the adjustable face value of the bond. The underwriter has to choose the underlying and the sensitivity of the face value to the underlying for each issue.

Common to these examples is the fact that the underwriter must choose several parameters for every issue within the product structure. These choices (e.g., the PERCS conversion cap) typically vary across issues. The role of the underwriter is not only to build the book but also to structure the issue, i.e., to customize it. The structuring skills of underwriters could be a potentially important source of differentiation between innovators and imitators.

Issue customizing has been well documented and it is depicted in the testimonies of bankers collected by Eccles and Crane (1988). In addition, Schroth (2006) analyzes the structuring of equity-linked issues and finds a significant variation across the parameters within the same designs. In fact, Schroth (2006) finds much less variation within the imitators' set of issues. Hence, it seems that even if the imitator learns the product design and competes with the innovator early, it lags in structuring skills.

More generally, the inherent characteristic of corporate innovations in these data is that the product design does not immediately disclose all the product information known to the innovator. The skill differential may show up in (i) the choice of the issue's parameters (e.g., floors, caps) within the security design; (ii) the provision of advice to issuers about the hedging of their liabilities;[5] or (iii) the resolution of legal or tax issues before the product can be issued[6] .

Other prominent financial vehicles not included in our sample share these features. For example, Goldman, Sachs and Co. pioneered and remained the lead underwriter of putable securities indexed to the Nikkei Index. The idea of issuing Nikkei Put warrants was disclosed rapidly to competitors but Goldman also hedged the issuer's exposure to the Nikkei privately, profiting from private information acquired during the development of the hybrid security.

2. Sequential innovation

Table II shows that innovation occur sequentially within a product group. Being in the same group, these products have common design features but later generations change or improve earlier designs. Consider the following example.

Dividend Enhanced Convertible Stock (DECS): DECS are also 3-year mandatorily convertible preferred shares, but they converts to one common share only if the stock appreciates more that $\bar{r}\%$ or if it depreciates. Otherwise, they convert to their fixed current common value (Figure 2). DECS are a third generation product derived from PERCS.[7]

<INSERT FIGURE 2 ABOUT HERE>

Table III compares the main characteristics of issues of first generations and later generations. Three observations stand out. For first generations, (i) issuers pay significantly lower underwriting fees; (ii) entry is significantly slower, measured as the number of issues to imitation; and (iii) the innovator has a significantly larger market share.

<INSERT TABLE III ABOUT HERE>

The facts that innovators of later generations have smaller market shares than first generation innovators and that entry speeds up for later generations suggest that the generation number may be an important, previously overlooked source of heterogeneity. In particular, it seems that the innovator's advantage may decrease with the security's generation number. This result is consistent with the intuition that, if the imitator needs to acquire specific skills to match the innovator, it is likely that part of the skills learnt from underwriting early generations will still be useful to underwrite late generation products. Therefore, the skill differential between the innovator and its imitators will be smaller and shorter lived for later generations.

Later generations may improve earlier designs and increase the choice of the issuer as to what to issue. The average increase in underwriting fees from the first to the later generations are consistent with this interpretation. Whether generations add value to the issuer at an increasing or decreasing rate along the sequence is an empirical issue, testable with the multivariate analysis we propose in Section II.

E Client loyalty

The loyalty of clients is a prominent feature of the investment banking literature. Bhattacharyya and Nanda (2000) argue corporate finance innovation is profitable because issuers are reluctant to break their relationships with their underwriter. The underwriter exploits this loyalty by increasing the underwriting fee above the competitive price without losing the underwriting mandate. We measure the relative client loyalty at each issue t of security g by the propensity that the issuer, x, has had in the past to choose bank b over its rivals b' to underwrite g. The index is:

$$LOYAL_{t,g,b,x} = \frac{\#(\text{issues between } x \text{ and } b)}{\sum\limits_{\forall b' \text{in market } g} \#(\text{issues between } x \text{ and } b')} - \frac{1}{\#(b' \text{ in market } g)}, \quad (1)$$

where #(issues between x and b) is the total number of past issues of any security since 1985 with the same issuer-underwriter pair; $\sum\limits_{\forall b' \text{in market } g}$ #(issues between x and b') is the sum of these counts for the same issuer over all banks that compete for security g and #(b' in market g) is the number of such banks.

The first term of this coefficient measures how much more likely the issuing firm was to choose this bank in the past over all the other underwriters of this security. The second term normalizes for the fact that the number of competing underwriters is heterogeneous across securities. A value of zero means that the issuer has chosen all of the competing banks with equal likelihood in the past. We also refine this measure by counting only past issues of securities of the same class, i.e., D, CD, P, or CP, instead of all issues.

<INSERT TABLE IV ABOUT HERE>

We see in Table IV that, regardless of its definition, the loyalty index exhibits very little variation: the inter-quartile range for both measures is zero. Moreover, the univariate test shows no significant difference between the average of either measure of loyalty to innovators or imitators (p-values of 0.46 and 0.13). Further, loyalty covaries little with whether the underwriter is the innovator or not (correlation of 0.05 and 0.09). Thus, it seems that loyalty will have a small impact on the dynamics of market shares and equilibrium underwriting fees when tested formally.

II An empirical model of the underwriting market

To analyze our data, consider the following stylized model of the underwriting market for corporate innovations. The issuer has to choose and underwriter, and the services of competing banks (innovator and imitators) are differentiated.

A The underwriting market

Let $t = 0$ denote the first issue of a new security, g. By definition, this security is underwritten by the innovator, $b = 0$. The design of g is immediately revealed to the imitating bank, $b = 1$ (the case with more than one imitator is developed in the Appendix and produces the same qualitative results). Let $t = 1, 2, ...$ denote the observed sequence of issues. We assume that one financing firm is drawn at each t and that each cannot delay the issue. Both underwriters bid for the mandate to structure and sell the security and compete in fees, p_b (i.e., the underwriting spread), to get the mandate.

B The underwriting service

The underwriting service provided by banks is differentiated both vertically and horizontally. The vertical dimension measures the quality of the product and the underwriting service, q_b: all other things being equal, an issuing firm prefers an underwriter who knows how to customize better the issue.

Let the quality differential $\Delta q \equiv q_0 - q_1$. Whenever the innovator has a superior expertise, then $\Delta q > 0$. To explore the superior expertise hypothesis, we let the quality differential depend on the number of issues and the generation number of the security and write it as $\Delta q\,(t, g)$. The innovator's initial advantage is therefore $\Delta q\,(0, g)$. If the imitator catches up with the innovator's underwriting skill as more issues occur, then $\Delta q\,(t, g)$ is decreasing in t for a given g. Further, if our previous intuition is correct and the skills learnt from underwriting early generations are useful to catch up faster with the innovator in later ones, then $\Delta q\,(0, g)$ is decreasing in g and $\Delta q\,(t, g) > \Delta q\,(t, g')$ for all $g' > g$.

The horizontal dimension represents the preferences of issuing firms for a particular bank. Issuers are "located" on a unit interval and their unit mass is uniformly distributed over it (we relax this assumption in the Section V). The two competing investment banks are located at the extremes, so that a firm $x \in [0, 1]$ is partial to one bank. Hence, the preferences of a firm at x for either bank are given by

$$\begin{aligned} v_0(x, g, t) &= q_0\,(t, g) - p_0 - sx, \\ v_1(x, g, t) &= q_1\,(t, g) - p_1 - s(1 - x), \end{aligned}$$

where s measures the intensity (unit cost) of loyalty. With this setup each bank has its own clientele of financing firms. The distance to either represents the degree of loyalty to both.

The drawn firm chooses its underwriter, b, to maximize v_b and has a reservation value normalized to zero, i.e., she cannot delay the financing. Each bank's profits per issue are

$$\pi_b \equiv (p_b - c)\, D_b(x, p_0, p_1, g, s, t) \qquad \text{for } b = 0, 1; \tag{2}$$

and where c represents the marginal cost of underwriting an issue (e.g., SEC filing, advertising, legal fees) and t the issue number.

C Testable implications of the equilibrium

The main sources of testable comparative statics in this model are s and Δq. All proofs to the propositions that follow are in the appendix.

1. Equilibrium entry time

Let $\hat{x}$ be the issuer that is indifferent between both banks that set a fee at marginal cost. That is, $\hat{x}$ solves

$$\begin{aligned} q_0(t,g) - c - s\hat{x} &= q_1(t,g) - c - s(1-\hat{x}), \\ &\Rightarrow \hat{x} = \frac{1}{2} + \frac{\Delta q(t,g)}{2s}. \end{aligned}$$

Whenever the innovator's expertise advantage is high relative to the intensity of loyalty of its clients, i.e., $\Delta q(t,g) > s$, then $\hat{x} > 1$ so that even the most loyal client to the imitator chooses the innovator in equilibrium. In equilibrium, the innovator chooses a fee that guarantees him the mandate for any issuer $x \in [0, \overline{x})$, where $\overline{x} \equiv \min(1, \hat{x})$. Similarly, the imitator gets mandates from issuers that are relatively loyal, i.e., for $x \in (\overline{x}, 1]$. The probability that an innovator gets the mandate is therefore $Pr(x \leq \overline{x})$, and Figure 3 illustrates both bank's mandate probabilities as a function of Δq.

<INSERT FIGURE 3 ABOUT HERE>

If $\Delta q(t,g)$ decreases with t for a given g, then the probability that the imitator gets the next mandate is zero until $\Delta q(t,g)$ becomes smaller than s. For any issue that follows, entry is a positive probability event and increasingly likely. The probability distribution of entry is characterized by the next proposition.

Proposition 1 *The probability distribution of the time of entry by the imitator at the N-th issue of security g is first order stochastically dominated by the distribution of the time of entry of security g' if and only if $\Delta q(g,t) < \Delta q(g',t)$.*

This result implies that imitation occurs, on average, sooner for smaller $\Delta q(0,g)$. Our hypothesis that $\Delta q(0,g)$ is decreasing in g implies that later generations are imitated faster.

This analysis has also implications about the speed and timing at which security innovations are introduced into the market. An innovator will choose not to underwrite immediately an issue of a new security if none of its close clients needs finance at that time. Indeed, underwriting an issue of a firm outside its usual, loyal, clientele is not as profitable for the bank because of the outsider's larger switching costs to bear. Hence, the innovator will delay the trigger of the imitator's learning process until it can make larger profits from the first. The innovator will either wait or aggressively market the product to its loyal clients with the aim of securing a more profitable underwriting contract and the highest continuation profits.

2. Equilibrium underwriting fees

For any $x \in [0, \overline{x})$, the innovator's equilibrium fee is obtained from the indifference condition

$$\begin{aligned} q_0\left(t,g\right) - p_0^* - sx &= q_1\left(t,g\right) - c - s(1-x), \\ &\Rightarrow p_0^*\left(t,g,s,x,c\right) = c + (1-2x)s + \Delta q\left(t,g\right). \end{aligned} \tag{3}$$

For any $x \in (\overline{x}, 1]$, the imitator's underwriting fee is

$$p_1^*\left(t,g,s,x,c\right) = c + (2x-1)s - \Delta q\left(t,g\right). \tag{4}$$

It is clear from (3) and (4) that, given c, x and s, the difference between the underwriting fee charged by the innovator and imitator follows the behavior of $\Delta q\left(t,g\right)$. Therefore, controlling for marginal costs of underwriting and for the intensity of loyalty, using (1), the equilibrium fee of the innovator is larger than that of the imitator, but the difference converges to zero in t if and only if $\Delta q\left(t,g\right)$ converges to zero in t for a given g.

Another testable implication of the superior expertise hypothesis is that the speed of convergence is increasing in $\Delta q\left(0,g\right)$. The initial advantage, $\Delta q\left(0,g,0\right)$, is identified by (3) and (4) through the comparison of innovators and imitators fees across g at $t=0$. Further, the speed of fee convergence is identified from the comparison of fees across issues within the same generation and underwriter.

D Discussion

The model above fully exploits the data by comparing the equilibrium fees, market shares, and the entry times of innovators and imitators over the life cycle of a security and across different securities ordered by their generation number. The model identifies the predictions of the superior expertise hypothesis from those of the client loyalty hypothesis by conditioning the issue outcomes on the *timing* of it, i.e., the issue's number and the security's generation number.

Note that client loyalty here plays an identical role as in Bhattacharyya and Nanda (2000). However, the loyalty hypothesis on its own, i.e., if $\Delta q\left(g,t\right) = 0$, would predict that imitation is immediate and that the fees and expected market shares differences between the innovator and its imitators are stationary.

This model takes the cost of switching as given and rules out the possibility that loyalty increases *during* the life cycle of the product. This assumption is borne by the data: no firm issues the same security more than once. The effects of increased loyalty on future innovations are discussed in Section V.

III Evidence from the timing of imitation

Proposition 1 implies that market entry by imitators occurs sooner on average for later generation products than for earlier generations if later generations increase the value to the issuer with respect to previous ones at a decreasing rate. Table III showed that late generations are indeed imitated faster than the first ones. Figure 4 takes a closer look by plotting the empirical cumulative distribution function (CDF) of the speed at which a security is imitated.

<INSERT FIGURE 4 ABOUT HERE>

The dotted line is the CDF of the number of issues before imitation for all first generation imitated securities in our data. The solid line is the CDF of the number of issues before imitation for all imitated later generation products. As predicted, the imitation time CDF of later generations first-order stochastically dominates the imitation time CDF of first generations.

A The hazard rate of imitation

For a precise test, we estimate a model of the survival time, i.e., the issue count, before a security is imitated. We take every issue of every imitated security before imitation and pair the issue number of each with the relevant covariates. With this data we estimate the parameters of

$$\lambda_{g,t} = \exp\{-(\beta_0 + \beta_1 g + \boldsymbol{\beta}_2 \mathbf{x}_{g,t} + \varepsilon)\}; \tag{5}$$

where $\lambda_{g,t}$ is the probability that security g is imitated immediately after issue t given that it has not yet been imitated. We use $\mathbf{x}_{gt}$ to capture characteristics of the market for security g that may speed up or slow down imitation. We use the total size of the market and the total number of issues ever. We also use the size of the first issue and the average size of all issues before t to approximate the imitator's expectations of the market size. We estimate β_0, β_1, and $\boldsymbol{\beta}_2$ by maximum likelihood, using standard errors estimators that are robustly consistent to heteroskedasticity and correlation within securities in the same group.

We assume that ε is log-normally distributed so that $-\ln \lambda_g$ is the conditional mean of the distribution of the log of the imitation time for security g. The log-normal assumption implies that the baseline hazard rate is initially zero and increasing, implying that, *ceteris paribus*, it is initially very hard for a competitor to imitate a new security yet as time passes it becomes easier. We omit our results for other distributional assumptions, but they are available in a supplement to the paper. As expected, the results are virtually identical when we use distributions of the generalized F class. These distributions imply an increasing baseline hazard rate and thus all the estimates and the goodness of fit measures are basically the same as in the log-normal case.[8]

B Results

The first column in Panel A of Table V shows the benchmark estimates of the parameters in (5). As predicted, a higher generation index is associated, on average, with a larger hazard rate and thus, with a faster expected imitation time. The estimate is significantly different from zero at the 95% level. The joint hypotheses that all parameters are zero is also rejected. All the other columns show the results when we use different security-specific controls. The estimate of β_1 is steady, negative and significantly different from zero with at least 95% confidence in all cases.

<INSERT TABLE V ABOUT HERE>

Our estimates of β_1 are also economically significant. Panel A of Table VI shows the estimated median times of the entry of imitators, $\frac{1}{\lambda}$, for different product generations. We calculate these estimates at all the quartiles and at the mean of the sample distribution of the control variables using the estimates in column 5. The predicted median imitation time of a first generation security is almost four issues. The median imitation time is reduced by one issue on average for fifth generations and to 1.5 for 15th generations.

<INSERT TABLE VI ABOUT HERE>

The estimates of $\boldsymbol{\beta}_2$ are positive and significantly different from zero to the 99% level when we use the total volume issued ever and the total number of issues ever (columns 2 and 3). Thus, imitation is slower on average for securities with bigger markets. Our interpretation for this result is that, as we argued before, the innovator has incentives to market aggressively the innovation to its close clientele, securing enough issues early before imitation effectively limits its market power. These incentives will be stronger for larger markets.

Approximating market size with ex-post measures has revealed more about the innovator's incentives to slow down imitation, conditional on g. To understand better the imitator's reaction, we use ex-ante measures of the market size, i.e., information about the market size available to the imitator as the market unfolds. The coefficients of the size of the first issue and the average size of all issues before t are either small or insignificant (columns 4 and 5). In column 6 we augment the specification to include also the standard deviation of the issue size before t. The coefficient is positive and significant with 95% confidence. Hence, the imitator's uncertainty about the market size is what drives his entry time over and above the generation number. More uncertainty delays the imitator's entry.

C Calendar time to imitation

We redo the hazard rate analysis of the model in (5) using the calendar times (days) after innovation instead of the issue numbers (t). The imitator's efforts to enter the market would not be well captured by deal counts if some of the first few issuers had been already captive clients of the innovator. Panel B of Table V shows the parameter estimates and Panel B of Table VI shows their implied imitation speeds.

We confirm that the speed of imitation increases in g regardless of the speed measure (issues or days): the estimates of β_1 are positive and significantly different from 0 with 99% or 95% confidence in all six columns. But the predictive roles of ex-ante and ex-post measures of market size have reversed. Ex-post measures have no effect on the hazard rate of imitation (columns 2 and 3) whereas ex-ante measures now have a negative and significant effect. Larger pre-imitation issues on average accelerate imitation in terms of days but not in terms of issue counts. Our initial interpretation is therefore strengthened. The larger the expected market size, the faster imitators will try to enter the market. They will achieve this goal in terms of calendar time but not in terms of the number of issues because the innovator will also move fast to secure initial mandates.

Figure 5 illustrates the survival probabilities (i.e., the probability that a security has not been imitated within a certain time) implied by the estimates above.

<INSERT FIGURE 5 ABOUT HERE>

D Summary

We have shown in this section that the main driver of imitation speeds is the security's generation number. This speed is increasing in g. This effect is robust to the measurement of the speed of imitation: the issue count or the number of days. On top of that effect, innovators slow down the entry of imitators by securing more underwriting mandates in larger markets. Imitators speed up their entry in markets they expect to be larger with less uncertainty.

IV Evidence from underwriting fees

From (3) and (4) , we learn that the difference between the underwriting fees of innovators and imitators, over and above bank-specific and issuer-specific characteristics, depends on the security's generation number, g, and the issue number within the security, t. We hypothesize that the innovator's fee is higher than the imitator's but the difference decreases in the issue number. The difference decreases faster the later the generation number of the security if and only if the innovator's initial advantage decreases with g.

A The econometric specification

We model the underwriting fee of issue t of security g as

$$p_{t,g} = \gamma_0 + \gamma_1 INN_b + \gamma_2 INN_b \times t \times g + \sigma LOYAL_{t,g,b,x} + \boldsymbol{\delta}'_w \mathbf{w}_t + \boldsymbol{\delta}'_z \mathbf{z}_{b,t} + \upsilon_l + \eta_{t,g}. \quad (6)$$

where $\gamma_1 INN_b + \gamma_2 \times t \times g$ measures $\Delta q(t,g)$. INN_b takes value 1 if the underwriter of issue t is the security's innovator and -1 otherwise. The initial expertise advantage of the innovator for generation g is $2(\gamma_1 + \gamma_2 g)$. A first test of the superior expertise hypothesis is that $\gamma_1 + \gamma_2 g > 0$ for every g in the sample.

The initial expertise advantage, $\Delta q(0,g)$, is decreasing with the generation number if and only if $\gamma_2 < 0$. If $\gamma_2 < 0$ then the advantage decreases at a rate of $-2\gamma_2 g$

per issue, i.e., faster for later generations. The implied issue number after which $\Delta q(t,g) = 0$ is given by $-\frac{\gamma_1}{\gamma_2 g}$.

$LOYAL_{t,g,b,x}$ is defined in equation (1). It measures the past likelihood of the issuer to choose underwriter b by the time of issue t of security g. Thus, it measures x. The parameter σ measures s and is interpreted as the importance of client loyalty for this segment of the underwriting market. For robustness, we reconstruct this measure counting: (i) only issues one year before t; and (ii) only issues of the same class, i.e., debt, convertible debt, preferred, or convertible preferred.

The vector $\mathbf{w}_t$ includes issue-specific controls to allow the underwriting fees to vary according to the marginal cost of underwriting an issue. We include the size of the issue (logarithm of the proceeds), and the security's maturity for issues of debt and convertible debt. We also include a dummy variable that takes value 1 if the issuer's debt is of investment grade. All specifications also include bank-specific characteristics through $\mathbf{z}_{b,t}$ to capture the fee variation due to differences in the reputation of the underwriter for placing an issue successfully. We use the bank's historical underwriting volume market shares for security g at t, and for all securities in the same class, $l = \{D, CD, P, CP\}$ as g.

We allow for further class-specific pricing differences trough υ_l. We estimate υ_l as a random or a fixed effect, and all the other parameters, $\boldsymbol{\gamma}$,σ, $\boldsymbol{\delta}_w$ and $\boldsymbol{\delta}_z$, accordingly. We include yearly specific dummies between 1986 and 2003 wherever noted. Finally, $\eta_{g,t}$ is the error term due to residual unobserved heterogeneity.

The specification above follows the empirical literature on underwriting fees (see Altinkilic and Hansen, 2000): it includes the issue size to capture economies of scale and issue and bank-specific measures to capture the increasing part of the marginal costs curve. It also includes bank-specific measures that capture the bank's generic underwriting service quality on top of the quality specific to the innovation. The new element in the specification above is that the comparisons of the underwriting fees are made across issues for a given security and across generations for given issue numbers. Tufano's (1989) failure to identify differences between innovator's and imitator's fees may have easily been caused by not making these two comparisons. Note too that our model relates the fees levels to quality *differences* between innovators and imitators and not to the quality *levels*. This is an important implication for the identification of superior expertise hypothesis in the sense that the effects of bank-specific characteristics in $\mathbf{z}_{b,t}$ account for pricing differences over and above the advantage intrinsic to the innovator, $\Delta q\,(t,g)$.

B Results and interpretation

Table VII shows the estimates of the parameters of (6). Columns 1 through 3 estimate the model using all issues of all imitated securities in the data. Columns 4 through 6 exclude the first issue of each security (18 observations). If the fee for the first issue was effectively set before imitators had any knowledge of the new security structure, then it would have been set by a monopolist rather than by a leading oligopolist. We compute a random and a fixed effects estimator for all six specifications and report the former. Columns 2,3,5 and 6 include year dummies and based on the Hausman test we cannot reject that v_l is uncorrelated with η_j. Thus, the inclusion of year dummies improves the specification and renders the random effects estimator consistent and efficient.

In consistency with the superior expertise hypothesis, the estimates of γ_1 are positive for all specifications. The confidence level increases from 90% (columns 2 and 3) to at least 95% (columns 5 and 6) after excluding the first issues of all securities. Recall that the average underwriting fee for imitated securities is 2.33%. Hence, the implied average excess equilibrium fee of innovators with respect to imitators, that is, $\frac{\hat{\gamma}_1}{2.33}$, ranges between 8.9% and 16.5%. Columns 5 and 6 also show higher R^2s and lower Hausman statistics than 2 and 3. As we expected, the specification in (6) fits much better the sample that excludes the first issue. The estimate of γ_2 is always negative and different from zero with 99% confidence across all specifications. This result shows that each innovation adds less value on average than its predecessor. The innovator's expertise advantage decreases as more issues are completed and decreases faster for later generation products. Note too how stable these estimates are across all specifications with year dummies.

<INSERT TABLE VII ABOUT HERE>

We can never reject that σ is different from zero for all specifications in Table VII. We obtain this result regardless of how we measure loyalty, i.e., either using the counts of underwriter-issuer pairs for all securities or only for securities in the same class l as g. This result is driven by the fact that issuers of corporate derivatives are frequent issuers of securities in general and keep relationships with all the top banks. The typical issuer seems impartial to all competitors. This fact leaves little room for the loyal clientele hypothesis, and the variation in underwriting fees is effectively explained by the inter-generational and inter-issue comparisons.

The coefficient of the logarithm of proceeds is negative and seems to capture the economies of scale in an offering. It is significant with 90% confidence for columns 4 and 5, where the fit of the model in general is the best. The variation in maturity and investment grade don't seem to capture the fees variation as well as the bank-specific variables. The fact that the coefficient for the bank's volume share of corporate derivatives underwriting is negative suggests that it is capturing the bank's lower underwriting cost. Recall that levels of bank-specific variables in this model explain fees levels through the marginal costs of underwriting or the underwriting quality in general (*not* security-specific). Thus, the bank's success as an underwriter of any security, measured by the bank's volume share in the class, has a positive and significant coefficient and, therefore, captures the bank's underwriting quality level in general.

Table VIII interprets the estimates shown above and analyzes their economic significance. The number of issues before the innovator's expertise advantage disappears is $-\frac{\hat{\gamma}_1}{\hat{\gamma}_2 g}$. It takes at least 10 issues for the imitator to compete at equal strength with the innovator in the underwriting market for first generation products. For 15th generation products, the innovator faces the toughest competition immediately after it has innovated. Note that this is another consistency check of our model: the initial innovator's advantage, $\gamma_1 + \gamma_2 g > 0$ is positive for every generation number in our sample ($g \leq 15$). It is never the case that the imitator starts with a lead. This is strong evidence that our econometric specification effectively identifies advantages intrinsic to innovation and not to other bank characteristics (e.g., reputation).

<INSERT TABLE VIII ABOUT HERE>

C Robustness

1. Allowing for monopolistic fees

The pricing model fits better the sample of issues *after* the monopolist issue. Our interpretation was that monopolist issues are priced differently. In fact, the fee set by the innovator before the security design is disclosed to the imitator is $p_0 = q_0 - sx$. Hence, the monopolist fee is independent of the marginal cost of underwriting and the innovator's advantage over the imitator. It depends on the loyalty of the client and the *level* of the innovator's underwriting quality. Therefore, we use the full sample of issues to estimate

$$\begin{aligned} p_{t,g} &= \gamma_0 + \sigma LOYAL_{t,g,b,x} + \boldsymbol{\delta}_z' \mathbf{z}_{b,t} + \upsilon_l \\ &\quad + I_{\{t>1\}} \times [\gamma_1 INN_b + \gamma_2 INN_b \times t \times g + \boldsymbol{\delta}_w' \mathbf{w}_t] + \eta_{t,g}, \end{aligned}$$

where $I_{\{t>1\}} = 1$ for all issues after the first, and zero otherwise. Columns 1 through 3 of Table IX show the results.

<INSERT TABLE IX ABOUT HERE>

The R^2s are very similar to those where we excluded the 18 monopolist issues. However, we gain a lot of precision in the estimation of γ_1 and γ_2. In particular, γ_1 is now significant at least with 95% confidence. The estimates are close to the previous ones. Therefore, the generation number and the issue number have significant economic effects on the speed of convergence of the imitator's expertise with that of the innovator. The implied speeds of convergence are very similar to those reported in Table VIII and we do not report them here. They are available upon request.

Note that the underwriter's historical volume share in the class is not interacted with the oligopoly dummy $I_{\{t>1\}}$ and it still has a significant and positive effect on the underwriting fee. On the other hand, the bank's volume share of only equity-linked and derivatives does interact with the oligopoly dummy and preserves the expected negative sign. These results strengthens our earlier conclusion that the volume share in the class affects the fees through the bank's underwriting quality *level* and the volume share of only recent innovations captures the marginal cost heterogeneity across banks.

2. Post-imitation fees

So far we have estimated the model as if the imitator exerted a competitive pressure over the underwriting fee either since the first issue or since the second. It is impossible to know for sure since when exactly this pressure was effective. We do know that every issue since the imitators first one occurs in an oligopoly and not a monopoly. Hence, we estimate the model restricting the sample to the 207 post-imitation issues.

As the selection of post-imitation issues may introduce a bias, we estimate the model

$$\begin{aligned} p_{t,g} &= \gamma_0 + \gamma_1 INN_b + \gamma_2 INN_b \times t \times g + \sigma LOYAL_{t,g,b,x} + \boldsymbol{\delta}'_w \mathbf{w}_t + \boldsymbol{\delta}'_z \mathbf{z}_{b,t} + \upsilon_l \\ &\quad + \delta_\lambda \lambda\left(t, \boldsymbol{\beta}'\mathbf{x}_g\right) + \tilde{\eta}_{t,g}, \end{aligned}$$

where $\lambda\left(t, \boldsymbol{\beta}'\mathbf{x}_g\right)$ is the inverse mills ratio derived from the hazard rate model of the time to imitation in (5).[9] Therefore, $\lambda\left(t, \boldsymbol{\beta}'\mathbf{x}_g\right) = -\frac{\phi\left(\frac{1}{\hat{\sigma}}\left(\ln t - \hat{\boldsymbol{\beta}}'\mathbf{x}_g\right)\right)}{\Phi\left(\frac{1}{\hat{\sigma}}\left(\ln t - \hat{\boldsymbol{\beta}}'\mathbf{x}_g\right)\right)}$ and $\hat{\boldsymbol{\beta}}$ and $\hat{\sigma}$ are the estimates shown in column 4 of Table V.

Columns 3 through 5 show the estimates with this correction. Qualitatively, the results are identical as those in Table VII. The R^2s have increased, and the loyalty measure has now a positive and significant coefficient to the 95% level (column 3). The estimates of γ_1 and γ_2 change little with this correction and our inference and conclusions remain unchanged.

D Summary

We have shown in this section that the observed underwriting fees fit very well the oligopoly model where innovators and imitators compete to get the next underwriting mandate. The comparison of the fees across issues within a generation and across generations for given issue numbers identifies the dynamic pattern of the innovator's quality advantage over its imitators: the innovator starts with an initial leadership that it uses to mark-up its issues while securing the mandate. This leadership decreases at a speed that is increasing in the generation number. The effects of this expertise advantage over the fees are of the first order, whereas the measures of client loyalty appear to have little or no predictive power.

V Further evidence and extensions

Below we present additional evidence found in our data and discuss some extensions to the model.

A Market shares

The next proposition characterizes the expected equilibrium market shares for the innovator and the imitator after any arbitrary number of issues of a security g using the equilibrium prices and the mandate probabilities for every (g, t).

Proposition 2 *The innovator's market share leadership over the imitator decreases with the number of issues within a security,* ceteris paribus. *The speed of market share convergence in the underwriting market for security g is larger than that for security g' if and only if $\Delta q(t, g) < \Delta q(t, g')$.*

The superior expertise hypothesis predicts that the demand for the innovator's underwriting services and its equilibrium market share are overall larger than the imitator's but that this difference decreases with time. Tufano (1989) finds the innovators of corporate securities between 1971 and 1989 have the largest overall underwriting market share. Panel B of Table III shows the same result for innovators of all imitated equity-linked and corporate derivatives. It also shows that the innovator's leadership is bigger for first generation securities.[10]

The model predicts that the less value added by an innovation the smaller the demand and the market share advantage and the shorter the expected duration of this leadership. Our evidence from underwriting fees shows that the value added per innovation is decreasing in the innovation's generation number. Therefore, the evidence found by Schroth (2006) is a direct test of our model: he estimates the demand for the innovators' and imitators' varieties of equity-linked and derivative corporate products over time and confirms that, on average, the market demand for the innovator's product is greater than that for the imitator's in an arbitrary time period. This study also finds that the difference between the demand for the innovator's and the imitators' underwriting services converge faster for later generations.

B The length of product life

Later generations typically improve and replace previous ones. Thus, the actual life span of a security depends on the speed at which a later generation product is developed. To understand this relationship, consider this simple extension. Let each innovation have a finite life of random duration. Let the probability that this security design is not replaced by a new one in the next period be $(1 - \delta)$. For parsimony, we abstract from time discounting. Indeed, the timing of this game reflects issues intervals rather than chronological intervals.[11]

After every issue of any given security, the innovator or the imitator may develop a new product in the group with probabilities δ_0 and δ_1, respectively. The probability that some bank innovates after t issues is

$$1 - (1 - \delta_0)(1 - \delta_1) \equiv \delta.$$

The expected number of issues before a given generation is replaced by the next equals $\frac{1}{\delta}$.[12] If the innovator uses his current expertise advantage also to develop next generations, then $\delta_0 > \delta_1$. The closer is δ_1 to δ_0, the higher is δ and the shorter is the life of the current generation. Thus, later generation products will be replaced faster by the next ones if $\delta_1 - \delta_0$ is decreasing in g. Panel B of Table III shows the observed number of issues per security. Later generations are shorter lived than the first.

C Which products are imitated?

The shorter the life of a security, the lower the probability that it will be imitated. Later generation products are imitated faster conditional on being imitated. But due to their shorter life expectancy, we would expect less imitation later in a product sequence.

There are 18 of the 50 innovations in this sample that are imitated. Table X shows the distributions of imitated and non-imitated products conditional on whether these are first or later generation products. First generation products are significantly more likely to be imitated than later generation products: we can reject the null hypothesis of no association between the imitation and the generation number with 95% confidence. One explanation is that as later generation products are shorter lived, it is less likely that an imitator will underwrite an issue of such a product. This is even the case if it takes, on average, fewer issues by the innovator for the imitator to enter the market.

<INSERT TABLE X ABOUT HERE>

D The profits from innovation

The expected profits for the innovator before issue $t = 0$ are

$$\Pi_0^e = -F_0 + \pi_0^e(0) + E\sum_{t=1}^{\infty}(1-\delta)^t \pi_0(t),$$

where $\pi_0^e(0)$ denotes the innovator's expected profits as the sole underwriter. Define $\dot{\Delta}q(g) \equiv \frac{\partial \Delta q(t,g)}{\partial t}$ as the speed at which the imitator's expertise converges to the innovator's. The incentives to innovate and imitate are characterized by the following proposition.

Proposition 3 *The innovator's total profits and the incentives to innovate increase with the innovator's initial expertise advantage* $\Delta q\,(g, 0)$ *and decrease with* $\dot{\Delta}q(g)$*. The imitator's total profits decrease with* $\Delta q\,(g, t)$ *and increase with* $\dot{\Delta}q(g)$*.*

In this model, the innovator has an incentive to innovate in markets where imitators can extract less information from an issue, i.e., where $\dot{\Delta}q(g)$ is low. This will be the case in highly volatile markets where changes in the economic environment may induce more variation in the structuring parameters across issues. Thus, innovation may occur more frequently in volatile markets not because issuing firms demand new securities that hedge increased risk but because in such markets banks would expect bigger and longer lived advantages as innovators.

E Do innovators always persist?

We assumed that issuers were symmetrically distributed on the unit interval according to their loyalty to either competing underwriter. No bank had an advantage over the other before innovating. We now explore the dynamics of the innovator's expertise advantage when the innovator and the imitators have clienteles of different sizes. To model this simply, we assume that clients are distributed on the unit interval according to a beta density function

$$f_\alpha(x) = \alpha x^{\alpha-1} \qquad 0 \leq x \leq 1,$$

which is parametrized by $\alpha > 0$. For $\alpha < 1$ the initial client base advantage goes to the innovator and for $\alpha > 1$ it goes to the imitator. When $\alpha = 1$ we have the uniform case. Note that the indifferent client's location is still at $\overline{x} = \min\left(1, \frac{1}{2} + \frac{\Delta q}{2s}\right)$ but what changes is the mass of clients located on both sides of $\overline{x}$.

The expected one period profits of the innovator and the profit difference in all cases are

$$\begin{aligned}
\pi_0^e &= \int_0^{\overline{x}} \left[(1-2x)s + \Delta q\right] \alpha x^{\alpha-1} dx = \begin{cases} \Delta q + s\frac{1-\alpha}{1+\alpha} \text{ for } \Delta q > s, \\ \frac{2s}{1+\alpha}\left(\frac{1}{2} + \frac{\Delta q}{2s}\right)^{1+\alpha} \text{ for } \Delta q < s, \end{cases} \\
\pi_1^e &= \begin{cases} 0 \text{ for } \Delta q > s, \\ \frac{s}{1+\alpha}\left(2\left(\frac{1}{2} + \frac{\Delta q}{2s}\right)^{1+\alpha} - (1-\alpha)\right) - \Delta q \text{ for } \Delta q < s. \end{cases}
\end{aligned}$$

where $\pi_0^e - \pi_1^e = \Delta q + s\frac{1-\alpha}{1+\alpha}$.

Proposition 4 *The larger the initial clientele of a bank, the greater the profits from each issue regardless of whether the bank is the product innovator or imitator.*

We learn from this result that the initial client base can have an important effect on the incentives to innovate. *Ceteris paribus*, it may not be profitable for a bank with a smaller *initial* client base to develop a new product that will later be imitated, whereas it may be profitable for a bank with a larger initial client base to do so. As a result, banks with larger client bases should innovate more often.

The above argument brings us to the relation between innovation and reputation. It is often argued that in the financial sector there are returns for being a leader rather than a follower. Many firms prefer to be clients of a bank that innovates more frequently than of one that does not innovate or does not innovate frequently. This effect can be captured in our model if we assume that every product innovation makes α decrease. If the potential developer of a new product can expand its client base, i.e., gain additional clients for its more traditional services as a result of an enhanced reputation, then it has an additional incentive to develop new products as in the future higher profits can be expected from a larger client base. Morgan Stanley's dominance in convertible preferred stock in the early and mid nineties is a notable example consistent with this prediction.

Taking the argument further, if switching costs or client loyalty were the main source of profits for an innovator, then we would expect the same banks to innovate very frequently along the product sequence and others to be persistently "relegated" to the role of imitators. On the contrary, Table X shows that a significant share of the later generation products are innovated by banks that did not develop the first generation product. Of the 39 innovations that appear after the first generation product, 33 were innovated by banks that did not develop the first generation product. Moreover, we have seen empirically that bank-specific reputation measures do affect positively the bank's fees but that the effect of being innovator has a strong effect *over and above* reputation.

F Corporate derivatives and comanaged underwriting

We find one more explanation in the literature of why patents are not necessary for corporate finance innovation. Nanda and Yun (1995) argue that banks coordinate their R&D effort as a joint venture to overcome the free-riding problem. We believe, however, that this hypothesis does not apply to our data and the types of securities described in this paper. Firstly, our data set and that used by Nanda and Yun have only one security in common. Secondly, of the 665 underwriting contracts for equity-linked and derivative corporate securities only 13 were jointly underwritten by two or more lead underwriters. In fact, the underwriting role was only shared once in the first issue of a security.

VI Conclusion

Our new evidence on the speed of entry of imitators into the market and the equilibrium underwriting fees for recent corporate product innovations reveals important dynamics that match the predictions of the superior expertise hypothesis and rule out other explanations.

The expertise advantage of the innovator makes it more likely that it will recoup the R&D costs obtaining a positive profit from the innovation even without patent protection. The ruling in *State Street Bank vs. Signature Financial Group* in 1999, where the US Supreme Court upheld a patent for a financial business method, has caused a well-documented run on patents (Lerner, 2000). Whether patent and copyright protection is a good idea in general remains a controversial question among economists today.[13] Our results suggest that *State Street* may have unnecessarily increased the incentives for innovation at the cost of increased litigation and defensive patenting by investment banks. The net effect on the amount of innovation and its profitability for investment banks remain to be seen and studied.

Appendix 1: Proofs

Proof of Proposition 1. The probability distribution that the imitator gets its first underwriting mandate at the $N-$th issue is

$$\Pr(N) = 1 - \Pi_{t=1}^{N-1} \left(\overline{x}_t\right),$$

where $\overline{x}_t$ is the probability that the innovator gets the t-th issue, i.e.,

$$\overline{x}_t = \min\left(1, \frac{1}{2} + \frac{\Delta q\left(t, g\right)}{2s}\right).$$

Clearly, $\Pr(N)$ decreases in $\Delta q\left(t, g\right)$ for every N. ■

Proof of Proposition 2 . The expected market share of the innovator after M issues (including $t = 0$) is

$$MS_0\left(M\right) = \left(1 + (N-1) + \sum_{t=N}^{M}\left(\frac{1}{2} + \frac{\Delta q\left(t, g\right)}{2s}\right)\right) / \left(M+1\right)$$

The expected market share of the imitator after $M + 1$ issues is

$$MS_1\left(M\right) = \left(\sum_{t=N}^{M}\left(\frac{1}{2} - \frac{\Delta q\left(t, g\right)}{2s}\right)\right) / \left(M+1\right),$$

The expected market share of the innovator is always larger than the expected market share of the imitator as long as $\Delta q\left(t, g\right) > 0$ but the difference is

$$MS_0\left(M\right) - MS_1\left(M\right) = \left(N + \frac{1}{s}\sum_{t=N}^{M}\Delta q\left(t, g\right)\right) / \left(M+1\right),$$

which is clearly decreasing in t if $\Delta q\left(t, g\right)$ is decreasing in t. Since $\Delta q\left(t, g\right) \leq s$ for $t \geq N$, then the innovator's market share is larger than the imitator's for any M. This happens for two reasons. First, the possible entry of the imitator is delayed. Second, even after entry, the probability that the imitator obtains the underwriting mandate is still smaller. Finally, it is clear that $MS_0\left(M\right) - MS_1\left(M\right)$ converges to zero if and only if $\Delta q\left(t, g\right)$ does. ■

Proof of Proposition 3. Let N be the first issue that the imitator can underwrite with positive probability. N solves

$$\Delta q\,(N-1,g) > s > \Delta q\,(N,g)\,.$$

For a non-increasing speed $\dot{\Delta q}\,(g)$, N is increasing in $\Delta q(g,0)$, decreasing in s, and decreasing in $\dot{\Delta q}\,(g)$. The expected profits per issue are

$$\begin{aligned}
\pi_0^e &= \int_0^{\overline{x}} (p_0^* - c)dx = \overline{x}\,((1-\overline{x})s + \Delta q\,(t,g)) = \begin{cases} \Delta q\,(t,g) \text{ for } \Delta q\,(t,g) > s, \\ s\left(\frac{1}{2} + \frac{\Delta q(t,g)}{2s}\right)^2 \text{ for } \Delta q\,(t,g) < s, \end{cases} \\
\pi_1^e &= \int_{\overline{x}}^1 (p_1^* - c)dx = (1-\overline{x})\,(\overline{x}s + \Delta q\,(t,g)) = \begin{cases} 0 \text{ for } \Delta q\,(t,g) > s, \\ \left(\frac{1}{2} - \frac{\Delta q(t,g)}{2s}\right)^2 \text{ for } \Delta q\,(t,g) < s. \end{cases}
\end{aligned}$$

The total expected profits from innovation are

$$\Pi_0^e = -F_0 + \pi_M^e + \sum_{t=1}^{N-1} (1-\delta)^t \Delta q\,(t,g) + \sum_{t=N}^{\infty} (1-\delta)^t s\left(\frac{1}{2} + \frac{\Delta q\,(t,g)}{2s}\right)^2,$$

where $\pi_M^e = q_0 - \left(c + \frac{s}{2}\right) > \Delta q(0,g)$.

The total expected profits from imitation account for the expected profits from the period when the probability of obtaining the underwriting contract becomes positive,

$$\Pi_1^e = \sum_{t=N}^{\infty} (1-\delta)^t s\left(\frac{1}{2} - \frac{\Delta q\,(t,g)}{2s}\right)^2.$$

Therefore, the imitator's total profits decrease with its initial quality disadvantage $\Delta q(0,g)$ and increase with $\dot{\Delta q}(g)$. ■

Proof of Proposition 4. Clearly, the innovator's profits per issue are decreasing in α, i.e., increasing in the initial client base. For the imitator

$$\frac{\partial \pi_1^e}{\partial \alpha} = \frac{2sB^{1+\alpha}\,(1 + \ln B) + 2\alpha}{(1+\alpha)^2} > 0$$

because $B = \left(\frac{1}{2} + \frac{\Delta q}{2s}\right) > \frac{1}{2}$. ■

Appendix 2: More imitators

Consider the case of one innovator ($b = 0$) and two imitators ($b = 1, 2$) that are located at the extremes of an equilateral triangle (Figure A2.1). The extension to more than two imitators is straight forward using higher-dimensional polygons.

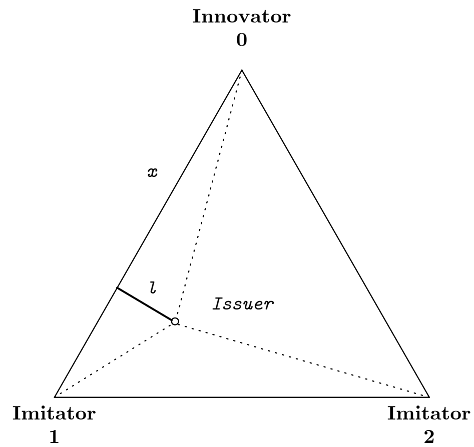

Figure A2. 1: Spatial representation of the issuer's preferences for three competing banks.

Since the two imitators have the same expertise, the imitator farthest from the issuer never obtains the underwriting mandate. Let $b = 1$ be, without loss of generality, the closest imitator. The values to the issuer located at $\mathbf{x} = (x, l)$ of choosing either underwriter are

$$\begin{aligned} v_0(x) &= q_0 - p_0 - sd\left(\mathbf{x}, 0\right), \\ v_1(x) &= q_1 - p_1 - sd\left(\mathbf{x}, 1\right), \end{aligned}$$

where d is the euclidean distance. Thus, $d\left(\mathbf{x}, 0\right) = \sqrt{x^2 + l^2}$ and $d\left(\mathbf{x}, 1\right) = \sqrt{\left(1 - x\right)^2 + l^2}$. The location of the indifferent client, $\hat{x}$, equates $v_0\left(\hat{x}, \hat{l}\right)$ to $v_1\left(\hat{x}, \hat{l}\right)$ for $p_1 = p_2 = c$. Thus, $\left(\hat{x}, \hat{l}\right)$ is defined implicitly by

$$\sqrt{\hat{x}^2 + \hat{l}^2} - \sqrt{\left(1 - \hat{x}\right)^2 + \hat{l}^2} = \frac{\Delta q}{s}, \tag{7}$$

which is a hyperbola with vertex on $\left(x = \frac{1}{2} + \frac{\Delta q}{2s}, l = 0\right)$ and with $\frac{\Delta q}{2s} < \frac{1}{2}$.The indifferent clients are those equidistant by$\frac{\Delta q}{s}$ to the two effective competitors, located at $(0, 0)$ and $(1, 0)$.

The value of $\hat{x}$ that preserves the equality (7) is increasing in Δq for any l.Hence, a higher expertise advantage of the innovator implies a larger clientele and a higher probability that the innovator will underwrite the next issue. Therefore, all the comparative statics of the two competitors model hold for any number of competitors because any bank's region of influence, i.e., its clientele, is increasing with its relative advantage (disadvantage), Δq $(-\Delta q)$.

Figure A2.2 below illustrates these comparative statics. Without any expertise advantage ($\Delta q = 0$) we have $\hat{x} = \frac{1}{2}$ for $l = 0$. The three banks have the same market share equal to $\frac{1}{3}$ (dotted lines). For a positive advantage, then $\hat{x} = \frac{\Delta q}{2s} + \frac{1}{2} > \frac{1}{2}$ for $l = 0$ and the innovator has the largest market share (solid lines). If the innovator's expertise advantage is high enough, i.e. $\frac{\Delta q}{s} > 1$, then the "indifferent" client curve lies outside the triangle, implying that the innovator surely underwrites the next issue surely.

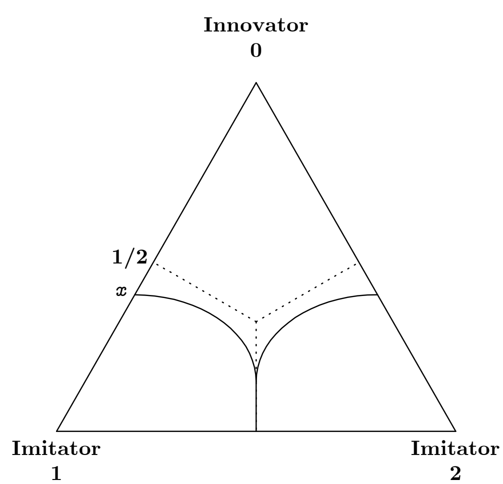

Figure A2. 2: Bank's clientels with and without the innovator's expertise advantage.

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Footnotes

1. Patents for financial innovations have become effective since the US Supreme Court for the first time validated a patent on a "business method" in 1999. See Lerner (2002) for the effects of 'State Street vs. Signature Financial Group' on financial patents, and Jaffee and Lerner (2004) for a comprehensive discussion of the pros and cons.

2. The total issued volume of equity-linked and derivative securities represents a very large share of the total volume underwritten by the participating banks. The average volume issued per underwriter of equity-linked and derivative securities between 1990 and 1999 was larger than the average issued volume of convertible preferred stock (e.g., 1.2 times larger between 1995 and 1999) and convertible debt (e.g., 1.1 times larger between 1995 and 1999), and about half of the issued volume of preferred stock. See Tufano (1995) and Finnerty (1992) for a general overview of innovation in corporate finance products. A more comprehensive survey of financial innovation is provided by Allen and Gale (1994).

3. The view that imitations are imperfect substitutes is summarized by the testimony of William Toy, a Managing Director at CDC Capital:

   > There is at least a perception that the first mover is more familiar with the product he issues than the imitator (personal interview, New York City, February 2001).

4. Innovative corporate products are classified by Schroth (2006) using securities descriptions from the Investment Dealers' Digest, American Banker and the Dow Jones Newswires. These sources provide at least one description of every product and a reference to a similar older product.

5. The underwriter may sometimes buy part of the issue, in which case it needs to understand the product's effect on the risk and returns of its portfolio. The case of the Nikkei Put Warrants introduced by Goldman, Sachs & Co. in 1990 illustrates this factor very well.

6. Goldman Sachs & Co. created MIPS and dominated their underwriting market mostly thanks to the research it conducted on Grand Cayman's corporate tax law. MIPS were vehicles to issue preferred stock through a Cayman-based subsidiary that would loan the entire proceeds to the already levered parent.

7. Subsequent generations of convertible preferred stock are ACES and PEPS. ACES convert one to one after 4 years with floors and caps. PEPS convert one to one after 4 years only if the common stock appreciates more than a threshold return.

8. Log-normality is more appealing theoretically and empirically over alternatives outside the F-class. The implied baseline hazard rate of other commonly used distributions, i.e., Exponential and Weibull, is time-invariant or decreasing, respectively, implying counter-intuitively that imitation becomes harder with time. Not surprisingly, the fit under these assumptions is poor, whereas the fit is good for all distributions of the generalized F class.

9. This equation is derived from the mean of the underwriting fee, conditional on the fact that the security has already been imitated. Thus, if N is the (random) imitation time, where $\ln N \sim N(\hat{\boldsymbol{\beta}}'\mathbf{x}_g, \hat{\sigma})$, then the true model's residual is

$$\begin{aligned} E\left(\eta_{g,t}|\text{security } g \text{ is already imitated}\right) &= E\left(\eta_{g,t}|t \geq N\right) \\ &= E\left(\eta_{g,t}|z \leq \frac{\ln t - \hat{\boldsymbol{\beta}}'\mathbf{x}_g}{\hat{\sigma}}\right) \\ &= \delta_\lambda \lambda\left(t, \hat{\boldsymbol{\beta}}'\mathbf{x}_g, \hat{\sigma}\right) + \tilde{\eta}_{g,t}, \end{aligned}$$

for $\lambda(.) = -\frac{\phi(.)}{\Phi(.)}$.

10. This is the share of the number of issues, as in Tufano (1989) and Schroth (2006), and not the share of the underwritten principal. The implicit assumption is that the amount of funds sought by the issuer is known by the time it chooses an underwriter.

11. Time discounting can be easily incorporated to the model if we let $(1 - \delta)$ be the product of the probability of continuation and the pure time discount.

12. We can also let δ_0 and δ_1 increase with every issue. This would speed up the introduction of later generations even more.

13. The most prominent recent cases against patent or copyright protection are made by Jaffee and Lerner (2004) and by Boldrin and Levine (2006).

Table I: Summary of all issues of equity-linked and dorporate derivative securities

This table presents summary statistics for all issues of equity-linked and corporate derivative securities. All such issues are recorded by the SDC and span the period between 1985 and 2004. The imitated securities (Panel B) are those that have been underwritten by more that one bank.

Panel A: All issues of all equity-linked and corporate derivatives (sample A)

	Number of observations	Median	Mean	Standard deviation
Proceeds per issue ($ millions)	661	150.00	233.89	299.44
Underwriting fee (percentage of proceeds)	518	3.00	2.41	1.16
Product life (total issues per security)	50	5.50	13.24	20.60

Panel B: All issues of imitated securities (sample B)

	Number of observations	Median	Mean	Standard deviation
Proceeds per issue ($ millions)	410	150.00	257.24	344.74
(t statisitc for $H_0 : \mu_A - \mu_B = 0$)			(-1.17)	
Underwriting fee (percentage)	314	3.10	2.33	1.10
(t statisitc for $H_0 : \mu_A - \mu_B = 0$)			(-0.98)	
Product life	18	13.00	22.78	28.88
(t statisitc for $H_0 : \mu_A - \mu_B = 0$)			(-1.15)	
Time to imitation				
(issues before imitation)	18	2.00	2.67	1.88
(days before imitation)	18	214.50	484.44	642.87
Market share of product innovator	18	0.53	0.57	0.23

[a] Estimates followed by ***, ** and * are statistically different from zero with 0.01, 0.05 and 0.1 significance levels, respectively.

Table II: Classification of equity-linked and corporate derivatives into product groups

This table shows the classification of all 50 equity-linked and corporate derivative securities into product groups. We follow the classification proposed by Schroth (2006) which is based on the structure and purpose of the security. Securities within groups are listed in the order of their appearance along the sequence. The imitated securities are those that have been underwritten by more than one bank. All issues of equity-linked and corporate derivative securities are recorded by the SDC and span the period between 1985 and 2004.

Product Group	Securities in the group	Imitated securities	Underwriters
Debt products	RISRS.	RISRS.	Everen, Kemper.
Zero-coupon convertible debt	LYONS.	LYONS.	Merrill Lynch, Paine Webber.
Dividend paying convertible debt	SIRENS, ICONS.		First Boston, Merrill Lynch.
Convertible preferred products	PERCS, YES Shares, DECS, ACES, X-Caps, PRIDES, PEPS, SAILS, STRYPES, MARCS, PEPS, MEDS, Trust-Originated Convertible Preferreds, TRACES.	PERCS, X-Caps, Trust-Originated Convertible Preferreds.	Baird, Credit Suisse, DLJ, Dean Witter, Goldman Sachs, JP Morgan, Lazard Fréres, Lehman Brothers, Merrill Lynch, Morgan Stanley, Paine Webber, Robertson, Salomon-Smith Barney, UBS.
Short-term, income deferring products	FRAPS.	FRAPS.	DLJ, Lehman Brothers, Merrill Lynch, Morgan Stanley.
Perpetual, income deferring products	MIPS, EPICS, MIDS, TOPRS, QUIDS, QUIPS, QUICS, Res-Caps, COPRS.	MIPS, MIDS, TOPRS, QUIDS, Res-Caps.	Bear Stearns, Goldman Sachs, Lehman Brothers, Merrill Lynch, Morgan Stanley-Dean Witter, Salomon Brothers, Smith-Barney, UBS.
Convertible, income deferring products	Convertible MIPS, TECONS, Convertible TOPRS, QDCs, EPPICS, TRUPS, Convertible QUIPS.	Convertible TOPRS, TRUPS.	First Union Capital, Goldman Sachs, JP Morgan, Keefe, Merrill Lynch, Morgan Stanley, Paine Webber, Salomon-Smith Barney.
Index-tied appreciation of principal	PERLS, SIRS, MITTS, SMARTS, Equity Participation Securities, CPNs, SUNS, CUBS.	PERLS, SIRS, SMARTS, Equity Participation Securities.	Bear Stearns, Goldman Sachs, Lehman Brothers, Merrill Lynch, Morgan Stanley, Paine Webber.
Stock-tied appreciation of principal	ELKS, YEELDS, CHIPS, PERQS.	ELKS.	Bear Stearns, Lehman Brothers, Morgan Stanley, Salomon-Smith Barney.
Privatization exchangeable debt	PENs.		Goldman Sachs.
Corporate pass-throughs	STOPS.		Deutsche Bank.

Table III: Comparison of issues of equity-linked and corporate derivative securities across generations

This table compares issues of first and later generation equity-linked and corporate derivative securities. All such issues are recorded by the SDC and span the period between 1985 and 2004. First generation securities are those that appear first in the sequence of innovation within each product group (Table II). The imitated securities (Panel B) are those that have been underwritten by more that one bank.

Panel A: All issues of all equity-linked and corporate derivatives	Number of observations	Median	Mean	Standard deviation
Proceeds per issue ($ millions)				
of first generation securities (1)	218	150.00	297.50	438.61
of later generations (2)	443	150.00	201.39	190.74
T statisitc for ($H_0 : \mu_1 - \mu_2 = 0$)			$(3.92)^{***}$	
Underwriting fee (percentage)				
of first generations (1)	163	1.25	1.72	1.07
of later generations (2)	355	3.15	2.77	1.01
T statisitc for ($H_0 : \mu_1 - \mu_2 = 0$)			$(-10.79)^{***}$	
Product life (issues per security)				
of first generations (1)	11	9.00	19.81	28.16
of later generations (2)	39	5.00	11.39	18.47
T statisitc for ($H_0 : \mu_1 - \mu_2 = 0$)			(1.18)	

Panel B: All issues of imitated securities	Number of observations	Median	Mean	Standard deviation
Proceeds per issue ($ millions)				
of first generation securities (1)	205	150.00	300.75	449.19
of later generations (2)	205	150.00	213.73	180.81
T statisitc for ($H_0 : \mu_1 - \mu_2 = 0$)			$(2.57)^{***}$	
Underwriting fee (percentage)				
of first generations (1)	154	1.19	1.70	1.09
of later generations (2)	160	3.15	2.94	0.69
T statisitc for ($H_0 : \mu_1 - \mu_2 = 0$)			$(-12.12)^{***}$	
Product life (issues per security)				
of first generations (1)	7	17	29.26	32.10
of later generations (2)	11	7	18.64	27.40
T statisitc for ($H_0 : \mu_1 - \mu_2 = 0$)			(−0.75)	
Time to imitation (issues before imitation)				
of first generations (1)	7	3	3.86	3.53
of later generations (2)	11	2	1.91	0.83
T statisitc for ($H_0 : \mu_1 - \mu_2 = 0$)			$(1.79)^{**}$	
Time to imitation (days before imitation)				
of first generations (1)	7	231	320.86	355.75
of later generations (2)	11	198	588.55	772.01
T statisitc for ($H_0 : \mu_1 - \mu_2 = 0$)			(−0.85)	
Market share of innovator				
of first generations (1)	7	0.70	0.69	0.20
of later generations (2)	11	0.50	0.49	0.21
T statisitc for ($H_0 : \mu_1 - \mu_2 = 0$)			$(2.07)^{**}$	

[a] Estimates followed by ***, ** and * are statistically different from zero with 0.01, 0.05 and 0.1 significance levels, respectively.

Table IV: Issuers' loyalty to underwriters

This table summarizes the issuers' loyalty measure. The relative issuer loyalty at each issue t of security g is measured by the propensity that the issuer, x, has had in the past to choose bank b over its rivals b' to underwrite g. The index is

$$LOYAL_{t,g,b,x} = \frac{\#(\text{issues between } x \text{ and } b)}{\sum\limits_{\forall b' \text{in market } g} \#(\text{issues between } x \text{ and } b')} - \frac{1}{\#(b' \text{ in market } g)},$$

where #(issues between x and b) is the total number of past issues of any security since 1985 with the same issuer-underwriter pair; $\sum\limits_{\forall b' \text{in market } g} \#(\text{issues between } x \text{ and } b')$ is the sum of these counts for the same issuer over all banks that compete for security g and #(b' in market g) is the number of such banks.

	Number of observations	Median	Mean	Standard deviation
LOYALTY				
overall	328	0.000	0.096	0.251
in the same product class	334	0.000	0.075	0.234
Overall *LOYALTY*				
to the innovator (IN)	302	0.000	0.100	0.246
to imitators (IM)	26	0.000	0.053	0.303
T statisitc for ($H_0 : \mu_{IN} - \mu_{IM} = 0$)			(0.92)	
Within the class *LOYALTY*				
to the innovator (IN)	302	0.000	0.080	0.232
to imitators (IM)	26	0.000	0.021	0.259
T statisitc for ($H_0 : \mu_{IN} - \mu_{IM} = 0$)			(1.23)	

[a] Estimates followed by ***, ** and * are statistically different from zero with 0.01, 0.05 and 0.1 significance levels, respectively.

Table V: Estimates of the imitation hazard rates model

This table shows the estimates of a model of the hazard rate of imitation of innovative securities. The estimation uses all issues before imitation of all imitated equity-linked and corporate derivative securities in SDC between 1985 and 2004. Every issue of every imitated security before imitation is paired with its issue number and covariates. The model estimated with this data is

$$\lambda_{g,t} = \exp\{-(\beta_0 + \beta_1 g + \boldsymbol{\beta}_2' \mathbf{x}_{g,t} + \varepsilon)\};$$

where $\lambda_{g,t}$ is the probability that security g is imitated immediately after issue t given that it has not yet been imitated. $\mathbf{x}_{gt}$ includes characteristics of the market for security g specified below. The parameters β_0, β_1, and $\boldsymbol{\beta}_2$ are estimated by maximum likelihood, using standard errors estimators that are robustly consistent to heteroskedasticity and correlation within securities in the same group. Standard errors are shown in brackets under the estimate. ε is assumed to be log-normally distributed. The estimates in Panel B corresponds to the same model where the time index, t, is measured in calendar time (days).

Panel A: Time to imitation measured by issue number

	(1)	(2)	(3)	(4)	(5)	(6)
Generation number	−0.072	−0.061	−0.064	−0.069	−0.067	−0.064
(g)	(0.029)**	(0.027)**	(0.027)**	(0.031)**	(0.030)**	(0.029)**
Total volume issued		8.980				
($ trillions)		(2.46)***				
Total number of			0.006			
issues			(0.002)***			
Size of first issue				0.490		
($ billions)				(0.275)*		
Average size of previous					0.602	0.007
issues ($ billions)					(0.353)*	(0.026)
Standard deviation of previous						0.964
issues size ($ billions)						(0.378)**
Constant	1.455	1.340	1.279	1.294	1.304	1.343
	(0.167)***	(0.171)***	(0.179)***	(0.218)***	(0.215)***	(0.214)***
Observations	48	48	48	48	48	48
χ^2 statistic	5.98	40.46	64.83	15.16	11.02	21.31
P-value of χ^2 statistic	0.000	0.000	0.000	0.000	0.000	0.000

Panel B: Time to imitation measured in days

	(1)	(2)	(3)	(4)	(5)	(6)
Generation number	−0.130	−0.137	−0.142	−0.140	−0.133	−0.146
(g)	(0.047)***	(0.045)***	(0.039)***	(0.061)**	(0.063)**	(0.073)**
Total volume issued		−5.750				
($ billions)		(6.453)				
Total number of			−0.009			
issues			(0.007)			
Size of first issue				−0.001		
($ millions)				(0.001)**		
Average size of previous					−0.002	−0.002
issues ($ millions)					(0.001)***	(0.000)***
Standard deviation of previous						−0.002
issues size ($ billions)						(0.002)
Constant	5.822	5.895	6.079	6.296	6.297	6.481
	(0.192)***	(0.223)***	(0.314)***	(0.320)***	(0.268)***	(0.389)***
Observations	48	48	48	48	48	48
χ^2 statistic	7.57	12.00	33.01	7.88	9.64	18.01
P-value of χ^2 statistic	0.006	0.002	0	0.019	0.008	0

[a] Estimates followed by ***, ** and * are statistically different from zero with 0.01, 0.05 and 0.1 significance levels, respectively.

Table VI: Economic significance of the estimates of the imitation hazard rates model

This table shows the estimated times of imitation, implied by the estimates in Table V. The predicted median time for the imitators entry is $\frac{1}{\hat{\lambda}}$, where

$$\hat{\lambda} = \exp(-(\hat{\beta}_0 + \hat{\beta}_1 g + \hat{\boldsymbol{\beta}}_2' \mathbf{x}_{g,t})).$$

Panel A: Time to imitation measured by issue number

The estimated model used to predicted the median imitation issue number is

$$\hat{\lambda} = \exp(-1.304 + 0.067 \times g + 0.602 \times \text{average size of previous issues}).$$

Moments of the sample distribution of the average previous issue size	Generation 1st	5th	10th	15th
1st quartile	3.627 (0.612)***	2.776 (0.266)***	1.988 (0.310)***	1.423 (0.410)***
Median	3.842 (0.566)***	2.941 (0.200)***	2.105 (0.316)***	1.507 (0.437)***
Mean	4.005 (0.541)***	3.066 (0.161)***	2.195 (0.330)***	1.571 (0.461)***
3rd quartile	4.385 (0.533)***	3.356 (0.177)***	2.403 (0.395)***	1.72 (0.530)***

Panel B: Time to imitation measured in days

The estimated model used to predicted the median imitation time, in days, is

$$\hat{\lambda} = \exp(-6.297 + 0.133 \times g + 0.002 \times \text{average size of previous issues}).$$

Moments of the sample distribution of the average previous issue size	Generation 1st	5th	10th	15th
1st quartile	411.292 (81.107)***	241.341 (61.065)***	123.946 (64.620)*	63.655 (52.320)
Median	349.547 (56.289)***	205.11 (52.497)***	105.339 (56.859)*	54.099 (45.686)
Mean	310.766 (44.063)***	182.354 (48.288)***	93.652 (52.060)*	48.097 (41.483)
3rd quartile	240.643 (32.000)***	141.207 (42.457)***	72.52 (43.372)*	37.244 (33.745)

[a] Estimates followed by ***, ** and * are statistically different from zero with 0.01, 0.05 and 0.1 significance levels, respectively.

Table VII: Estimates of the equilibrium underwriting fee model's parameters

This table shows the estimates of the parameters of the equilibrium underwriting fee model, where the fee for issue t of a generation g security is

$$p_{t,g} = \gamma_0 + \gamma_1 INN_b + \gamma_2 INN_b \times t \times g + \sigma LOYAL_{t,g,b,x} + \boldsymbol{\delta}'_w \mathbf{w}_t + \boldsymbol{\delta}'_z \mathbf{z}_{b,t} + \upsilon_l + \eta_{t,g}.$$

and $INN_b = 1$ if the underwriter of issue t is the security's innovator and -1 otherwise; $LOYAL_{t,g,b,x}$ measures the past likelihood of the issuer to choose underwriter b by the time of issue t of security g;the vectors w_t and $z_{b,t}$ include issue-specific and bank-specific controls, respectively, and are listed below. The term υ_l captures class-specific pricing differences, where $l = \{$Debt (D), Convertible debt (CD), Preferred (P) and Convertible preferred (CP)$\}$. We estimate υ_l and the parameters with a random (RE) and a fixed effects estimator and report the RE estimates, their standard errors (underneath, in brackets), and the Hausman test statistic. The data includes all 237 issues of the 18 imitated equity-linked and corporate derivatives in the SDC data between 1985 and 2004.

Parameter	(1)	(2)	(3)	(4)	(5)	(6)
γ_1	0.323	0.208	0.209	0.386	0.258	0.259
	(0.117)***	(0.112)*	(0.112)*	(0.118)***	(0.114)**	(0.114)**
γ_2	−0.020	−0.022	−0.023	−0.021	−0.023	−0.023
	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***
σ, where $LOYALTY$ is:						
(i) based on all same bank-issuer	0.167	0.147		0.175	0.164	
pairs in the past	(0.219)	(0.205)		(0.224)	(0.210)	
(ii) based on all same bank-issuer			0.135			0.172
pairs in the same class as g			(0.217)			(0.222)
$\boldsymbol{\delta}_w$						
Logarithm of proceeds	−0.080	−0.099	−0.101	−0.089	−0.123	−0.125
($ million)	(0.072)	(0.071)	(0.071)	(0.074)	(0.073)*	(0.073)*
Maturity (in years,	0.007	−0.002	−0.002	0.003	−0.004	−0.005
D and CD only)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
Investment grade? (1 if yes,	−0.704	−0.272	−0.268	−0.623	−0.183	−0.178
0 if no, D and CD)	(0.162)***	(0.168)	(0.168)	(0.167)***	(0.172)	(0.172)
Share of equity-linked issues	−2.278	−1.101	−1.122	−2.496	−1.394	−1.426
by this bank	(0.313)***	(0.414)***	(0.412)***	(0.322)***	(0.486)***	(0.482)***
$\boldsymbol{\delta}_z$						
Share of all issues in the same	1.259	1.137	1.138	1.079	1.137	1.128
class as g by this bank	(0.391)***	(0.606)***	(0.606)***	(0.401)***	(0.720)***	(0.718)***
Year dummies	No	Yes	Yes	No	Yes	Yes
(1986-2003)						
γ_0	3.400	2.107	2.130	3.550	2.596	2.636
	(0.466)***	(0.493)**	(0.495)**	(0.490)**	(0.537)**	(0.540)**
Observations	273	273	273	256	256	256
R^2	0.465	0.583	0.582	0.487	0.605	0.605
Wald test χ^2 statistic	229.041	344.684	344.380	234.890	352.653	352.609
P-value	0.000	0.000	0.000	0.000	0.000	0.000
Hausman test statistic	69.435	30.894	30.795	64.604	24.486	24.471
P-value	0.000	0.193	0.196	0.000	0.491	0.492

[a] Estimates followed by ***, ** and * are statistically different from zero with 0.01, 0.05 and 0.1 significance levels, respectively.

Table VIII: Economic significance of the estimates of the pricing equation

This table shows the estimates of the expected duration of the innovator's advantage implied by the estimates of the underwriting fee model reported in Table VII. The expected advantage duration for security g is the number of issues after which the innovator and imitators compete at equal strentgh. The estimated advantage is

$$\Delta q\,(g,t) = \hat{\gamma}_1 INN_b + \hat{\gamma}_2 INN_b \times t \times g,$$

and it lasts for $t = -\frac{\hat{\gamma}_1}{\hat{\gamma}_2 g}$ issues. Each column uses the estimates of the corresponding column of Table VII.

			$-\frac{\hat{\gamma}_1}{\hat{\gamma}_2 g}$			
Generation	(1)	(2)	(3)	(4)	(5)	(6)
1	16.036	9.323	9.282	18.661	11.428	11.375
	(5.912)***	(4.923)*	(4.886)*	(5.904)***	(4.978)**	(4.94)**
5	3.207	1.865	1.856	3.732	2.286	2.275
	(1.182)***	(0.985)*	(0.977)*	(1.181)***	(0.996)**	(0.988)**
10	1.604	0.932	0.928	1.866	1.143	1.138
	(0.591)***	(0.492)*	(0.489)*	(0.59)***	(0.498)**	(0.494)**
15	1.069	0.622	0.619	1.244	0.762	0.758
	(0.394)***	(0.328)*	(0.326)*	(0.394)***	(0.332)**	(0.329)**

[a] Estimates followed by ***, ** and * are statistically different from zero with 0.01, 0.05 and 0.1 significance levels, respectively.

Table IX: Estimates of the equilibrium underwriting fee model's parameters

This table shows the estimates of the parameters of the equilibrium underwriting fee model. For columns 1 to 3, the fee for issue t of a generation g security is

$$p_{t,g} = \gamma_0 + \sigma LOYAL_{t,g,b,x} + \boldsymbol{\delta}'_z \mathbf{z}_{b,t} + \upsilon_l + I_{\{t>1\}} \times \left[\gamma_1 INN_b + \gamma_2 INN_b \times t \times g + \boldsymbol{\delta}'_w \mathbf{w}_t\right] + \eta_{t,g},$$

where $INN_b = 1$ if the underwriter of issue t is the security's innovator and -1 otherwise; $LOYAL_{t,g,b,x}$ measures the past likelihood of the issuer to choose underwriter b by the time of issue t of security g;the vectors w_t and $z_{b,t}$ include issue-specific and bank-specific controls, respectively, and are listed below; $I_{\{t>1\}} = 1$ for all issues after the first, and zero otherwise.The term υ_l captures class-specific pricing differences, where $l = \{$Debt (D), Convertible debt (CD), Preferred (P) and Convertible preferred (CP)$\}$. For columns 4 to 6, the fee for issue t of security g is

$$p_{t,g} = \gamma_0 + \gamma_1 INN_b + \gamma_2 INN_b \times t \times g + \sigma LOYAL_{t,g,b,x} + \boldsymbol{\delta}'_w \mathbf{w}_t + \boldsymbol{\delta}'_z \mathbf{z}_{b,t} + \upsilon_l + \delta_\lambda \lambda\left(t, \boldsymbol{\beta}'\mathbf{x}_g\right) + \tilde{\eta}_{t,g},$$

where $\lambda\left(t, \boldsymbol{\beta}'\mathbf{x}_g\right) = -\frac{\phi\left(\frac{1}{\hat{\sigma}}\left(\ln t - \hat{\boldsymbol{\beta}}'\mathbf{x}_g\right)\right)}{\Phi\left(\frac{1}{\hat{\sigma}}\left(\ln t - \hat{\boldsymbol{\beta}}'\mathbf{x}_g\right)\right)}$ is the inverse mills ratio derived from the hazard rate model of the time to imitation in column 4 of Table V. We estimate υ_l and the parameters with a random (RE) and a fixed effects estimator and report the RE estimates, their standard errors (underneath, in brackets), and the Hausman test statistic. The data includes all 237 issues of the 18 imitated equity-linked and corporate derivatives in the SDC data between 1985 and 2004. The first model is estimated with the full sample and the second with all issues after imitation has occured.

Parameter	(1)	(2)	(3)	(4)	(5)	(6)
γ_1	0.378	0.244	0.245	0.327	0.269	0.277
	(0.120)***	(0.111)**	(0.111)**	(0.125)***	(0.113)**	(0.112)**
γ_2	−0.024	−0.025	−0.025	−0.017	−0.022	−0.022
	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***
σ, where $LOYALTY$ is:						
(i) based on all same bank-issuer	0.128	0.107		0.329	0.163	
pairs in the past	(0.218)	(0.197)		(0.162)**	(0.140)	
(ii) based on all same bank-issuer			0.096			0.197
pairs in the same class as g			(0.207)			(0.152)
$\boldsymbol{\delta}_w$						
Logarithm of proceeds	−0.074	−0.071	−0.071	0.055	−0.058	−0.060
($ million)	(0.047)	(0.043)*	(0.043)*	(0.061)	(0.056)	(0.056)
Maturity (in years,	−0.994	−1.384	−1.381	−0.006	−0.004	−0.005
D and CD only)	(0.580)*	(0.528)***	(0.528)***	(0.008)	(0.007)	(0.007)
Investment grade? (1 if yes,	2.296	4.068	4.054	−0.450	−0.109	−0.102
0 if no, D and CD)	(2.257)	(2.087)*	(2.086)*	(0.121)***	(0.113)	(0.113)
Share of equity-linked issues	−2.729	−1.276	−1.292	−2.79	−1.459	−1.529
by this bank	(0.308)***	(0.409)***	(0.407)***	(0.254)***	(0.396)***	(0.395)***
$\boldsymbol{\delta}_z$						
Share of all issues in the same	1.675	1.240	1.239	1.396	1.643	1.619
class as g by this bank	(0.434)***	(0.438)***	(0.440)***	(0.366)***	(0.371)***	(0.373)***
Year dummies (1986-2003)	No	Yes	Yes	No	Yes	Yes
δ_λ				2.858	−0.009	0.014
(inverse Mills ratio)				(1.133)**	(1.122)	(1.122)
γ_0	2.951	1.673	1.686	1.956	2.197	2.263
	(0.149)***	(0.499)***	(0.498)***	(0.540)***	(0.653)***	(0.649)***
Observations	273	273	273	207	207	207
R^2	0.453	0.602	0.602	0.692	0.805	0.805
Wald test χ^2 statistic	218.360	374.050	373.850	483.430	816.580	818.290
P-value						
Hausman test statistic	18.168	25.136	25.234	88.657	29.246	28.924
P-value	0.020	0.455	0.449	0.000	0.211	0.223

[a] Estimates followed by ***, ** and * are statistically different from zero with 0.01, 0.05 and 0.1 significance levels, respectively.

Table X: Further evidence

Panel A of this table shows the frequencies of imitated and non-imitated securities conditional on whether or not they are the first generation in their group. There are 50 equity-linked and corporate derivative securities in the SDC and of these, 11 are first generation products. The χ^2 Pearson statistic is computed under the null hypothesis is that there is no statistical association between whether the security is imitated or not and whether the security is a first generation or not. Panel B shows the distribution of the number of times that a bank innovates along a given sequence of products conditional on whether or not the bank was the first innovator of the group. There are 61 bank-product group pairs for all the 50 equity-linked and corporate derivative securities in the SDC and, of these pairs, 11 correspond to the banks that developed the first generation product in each group. The rest correspond to the banks that competed in the same group either as imitators or as innovators of later generation products.

Panel A: was the security imitated?

		No	Yes	Total
First generation securities	Number	4	7	11
	Percentage	36.36%	63.64%	
Later generation securities	Number	29	11	39
	Percentage	74.36%	25.64%	

χ^2 Pearson statistic = 4.9332; P-value = 0.026.

Panel B: do innovators persist?

		Number of subsequent innovations by the bank in the same group					
		0	1	2	3	4	Total
Banks that are the group innovator	Number	28	16	3	1	2	50
	Percentage	56.00%	32.00%	6.00%	2.00%	4.00%	
Banks that are not the group innovator	Number	0	8	1	1	1	11
	Percentage	0.00%	72.73%	9.09%	9.09%	9.09%	

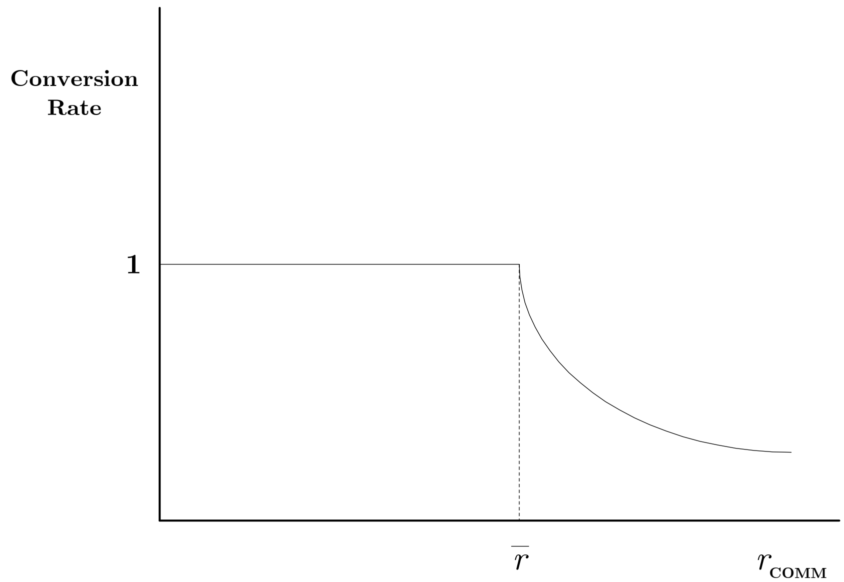

Figure 1: The conversion rate of a Preferred Equity Redeemable Stock (PERCS) as a function of the returns of the underlying common stock. Each unit of this preferred stock converts mandatorily after 3 years to one unit of common stock unless the common stock appreciates above a cap of $\overline{r}$ percent. If after 3 years the common stock appreciates above the cap, PERCS convert to less than one unit of common stock such that their conversion value is that of a stock that has appreciated by $\overline{r}$ percent.

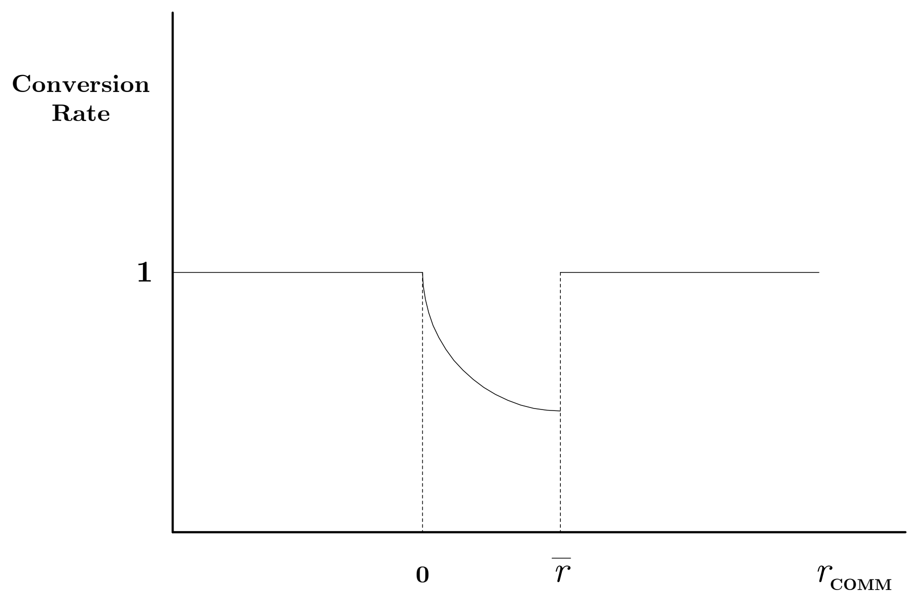

Figure 2: The conversion rate of a Dividend Enhanced Convertible Stock (DECS) as a function of the returns of the underlying common stock. Each unit of this preferred stock converts mandatorily after 3 years to one unit of common stock unless the common stock appreciates within 0 and $\overline{r}$ percent. If the common stock appreciates within these boundaries in 3 years, then DECS convert to less than one unit of common stock such that their conversion value is that of the stock's price at the issue date.

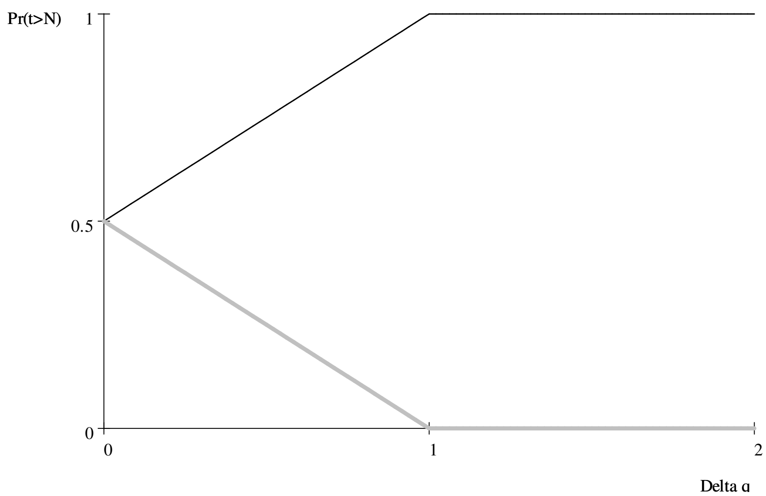

Figure 3: Probability that the underwriter of the next issue is the product innovator (black line) or its imitator (gray line) as a function of the quality differential (Δq). This figure illustrates the choice of an underwriter by the issuer of a new security. The black line plots the probability that the issuer chooses the innovator, as a function of the difference between the quality of the underwriting service provided by the innovator or the imitator. The gray line plots the probability that the issuer chooses the imitator. The larger the Δq, the higher the probability that the innovator gets the next contract. For a large enough Δq, then any issuer will prefer the innovator and the probability that the innovator gets the mandate 1.

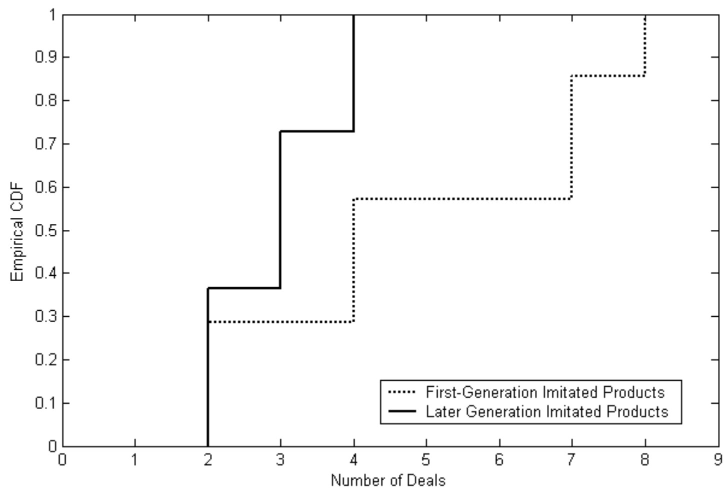

Figure 4: Empirical cumulative distribution function of the speed at which a security is imitated. This figure illustrates the speed at which a security is imitated conditional on its generation index. The speed of imitation is measured by the number issues it takes before an imitator completes its first issue. A security is said to be imitated if a bank other than the innovator underwrites an issue using the same product structure. The dotted line is the CDF corresponding to those imitated securities that were first generation products, i.e., the first product in a sequence of related products. The solid line is the CDF of the speed of imitation of products that appear in the sequence after the first generation product.

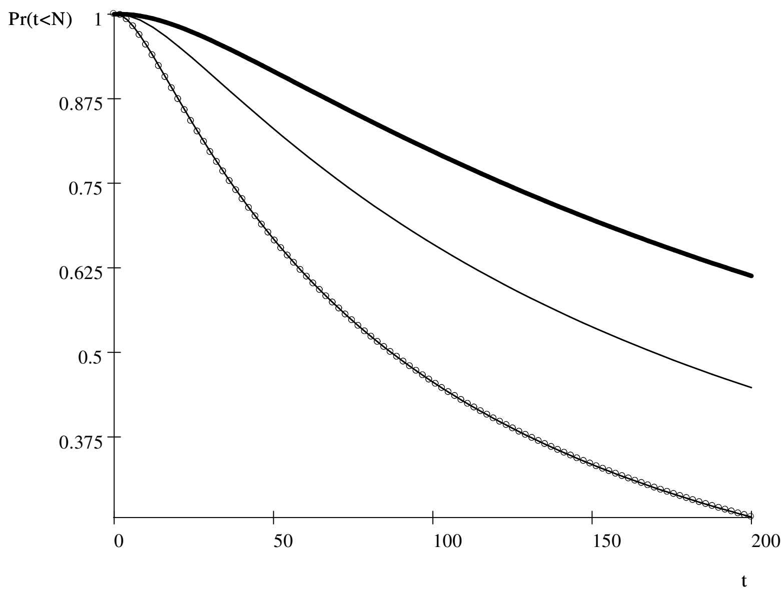

Figure 5: Probabilities that a security is not imitated within t days from the date of its first issue ($Pr(N > t)$). The thick solid line corresponds to first generation securities. The thin line corresponds to 5th generation securities and the dotted line to 10th generation securities. This figure shows the probability that a security is not imitated within t days of its first issue, conditional on its generation index. The probability that imitation time, N, occurs after t, i.e., the survival rates $S(t) = \Pr(N > t)$, is measured in the vertical axis and shown as a function of time which is shown in the horizontal axis. The survival rate is given by $S(t) = \Phi(-\frac{1}{\widehat{\sigma}} \ln(\widehat{\lambda} t))$, where $\widehat{\lambda}$ is the estimated imitation hazard rate which is itself obtained from the estimated hazard rate model: $\widehat{\lambda} = \exp(-6.297 + 0.133 * \mathit{generation} + 0.002 * \mathit{mean\ prior\ issue\ size})$, and $\widehat{\sigma} = 1.273907$. The thick solid line corresponds to the first generation securities. The thin line corresponds to the 5th generation securities and the dotted line to the 10th generation securities.